

changed, the thickness of a coat formed on a workpiece is adjusted.

Figs.6A and 6B are schematic illustrations for explaining an electrode material which adheres to a workpiece. Fig.7 is a view showing changes in the electric current density and the diameter of the electric discharge arc column when the time passes from the start of electric discharge. In Figs.6A and 6B, reference numeral 1 is an electrode for electric discharge surface treatment, reference numeral 2 is a workpiece, reference numeral 10 is an electric discharge arc column, reference numeral 11 is an electrode component emitted by vaporization and explosion when it is heated quickly, and reference numeral 12 is an electrode component adhering to the workpiece 2. As shown in Figs.6A and 7, immediately after the generation of electric discharge, the diameter of the arc column 10 is small, and the density of electric current is very high. Different from a normal electrode for electric discharge treatment for conducting a removal processing, heat conduction and mechanical strength of the electrode for electric discharge surface treatment are intentionally decreased for enhancing the productivity of surface treatment work. Accordingly, as shown in Fig.6A, when the density of electric current is high, a portion of the electrode 1 for electric discharge surface treatment close

to the electric discharge arc column 10 is quickly heated, and the portion of the electrode 1 for electric discharge surface treatment is vaporized and exploded and scattered to the periphery (into the processing solution). In this case, the electrode component 11, which has been quickly heated, vaporized and exploded, is quickly cooled by the processing solution. Therefore, it can not become a hard coat of the workpiece 2. On the other hand, when the density of electric current is appropriate, as shown in Fig.6B, the diameter of the electric discharge arc column 10 is extended. Therefore, a wide range of the electrode 1 for electric discharge surface treatment is heated, so that a quantity of electrode component 12 adhering to the workpiece 2 is raised.

As described above, according to the electric discharge current of a rectangular wave-form (shown in Fig.5) which is created by the conventional electric power unit for electric discharge surface treatment, even when peak value  $I_p$  of the electric discharge current pulse is increased for enhancing the productivity of surface treatment, a ratio of adhesion of the electrode material to the workpiece is low. Consequently, the ratio of adhesion of the electrode material to the workpiece is about 10wt% to 50wt%. That is, the electrode material is wasted, so that the cost of surface treatment is increased.

According to the electric discharge surface treatment method, the electrode material is emitted by heat of the electric discharge, and a portion of the thus emitted electrode material melts and adheres to the surface of the workpiece so that a hard coat can be formed. Accordingly, the electric discharge energy has two functions. One is a function of emitting the electrode material, and the other is a function of emitting the electrode material and melting the workpiece to each other. Figs.8A and 8B are photographs showing a surface of a workpiece in the case where electric discharge surface treatment is conducted on a workpiece made of steel by one shot of electric discharge current pulse. The photograph shown in Fig.8A shows a case in which a quantity of emitted electrode material is too large, and Fig.8B shows a case in which a quantity of emitted electrode material is too small. In the case where the quantity of emitted electrode material is too large as shown in Fig.8A, the electrode material, which has been emitted by electric discharge energy, can not be sufficiently melted, and it is impossible to form a tight hard coat on the workpiece. In the case where the quantity of emitted electrode material is too small as shown in Fig.8B, the workpiece is excessively melted, and an excessively large quantity of the workpiece is removed which exceeds a quantity of the workpiece appropriate for